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ON COMPARATIVE MICROMETER MEASURES.

IN A LETTER

FROM THE REV. DR. J. A. HAMILTON, DEAN OF CLOYNE,

TO THE REV. J. BRINKLEY, F.R.S.

READ, FEB. 4th, 1805.

DEAR SIR,

OBSERVATORY, ARMAGH, JAN. 10, 1805

I BEG leave, through you, to communicate to our Academy the following paper, on comparative observations made with different kinds of micrometers; which, I hope, may be deemed worthy their notice. It was suggested to me, so long since as in the year 1794, that a comparative view of the result of the measures, made under similar circumstances, of the diameters of the heavenly bodies, with the different kinds of micrometers, that are now most generally used by astronomers, might have considerable use; as well in confirming the determinations of the values of the diameters, as given by former observations, as in deciding on the merits of the different instruments, and shewing, at one view, a sort of harmony of micrometers. My own opinion, on this subject, entirely coinciding with that of the learned friend, who made this proposal, I set about making comparative observations of the measures of the sun's diameters.

meters, as taken with the old wire micrometer, made in the best manner, by Mr. Dolland; with his divided object-glass micrometer; and with a ten-inch reflecting sextant, executed, in a very capital stile indeed, by Messrs. Troughton.

Before I proceed to the detail of the observations, it may be proper to premise a short account of the nature and adjustments of the several instruments, that were the subjects of this experiment. The wire micrometer, as its name denotes, measures intervals, by the separation of two moveable wires: these wires should perfectly coincide, when the index of the scale marks 0 or zero: and the quantity of the separation of the wires, made by the turning of the screw which effects it, is denoted by revolutions, and parts of revolutions, of the index, over a graduated circle, attached to the micrometer's screw; which, in this instrument, consists of fifty sub-divisions. There are several ways of ascertaining the values of these revolutions and sub-divisions, in arcs of a great circle in the heavens. The method which I adopted was this: the microscope being fitted to an achromatic telescope, on an equatorial stand, I carefully separated the wires by fifteen exact revolutions; and then turning round the whole system, till a fixed wire, at right angles to the measuring wires, was in a plane parallel to the equator, I measured, by the sydereal clock, the time the sun's limb, and various fixed stars took, to run along the fixed wire, from centre to centre of the measuring wires. This trial was very frequently and repeatedly made; and the stars and sun's limb, being all reduced to the equator, the general

general result gave 121″,1, for the equatorial interval of the fifteen revolutions. This interval, reduced to space, made each revolution of the figured head = to 2′ and 1″ of measure; and, of course, each of the fifty sub-divisions = to 2″,42 nearly of an arch of the equator. In making the subsequent measures of the sun's diameter, or that of any other celestial arc, the measure was always finished, by moving the wire in the direction in which the fifteen revolutions were originally made. The advantage of this micrometer is principally this: that, in adjusting the telescope, and the micrometer wires, to distinct vision, no alteration is made, by the difference of the conformation of the eye, or of focal distance, that suits that of the observer, in the value of the arc to be measured. The principal defects of it are: the difficulty of judging accurately of bisections, or contacts of the fine wires, by the limbs to be measured; and the impossibility of observing any diameter, except the one perpendicular to the equator.

The object-glass micrometer is an instrument, now so familiar to every person conversant in the use of astronomical instruments, that it is only necessary to say, that mine was made, and adapted to a triple object-glass achromatic telescope, of 42 inches focal distance, by Mr. Dolland, and its scale very carefully verified by himself; and that the scale is, as usual, divided into inches, 10ths, 20ths, and vernier divisions: that, when it is applied, it lengthens the focal distance of the telescope about 6 inches; thus making it 48 inches, or 4 feet focal distance.

The advantages of this species of micrometer are: the large scale, the fine images formed, and the facility of measuring diameters in every possible direction. Its imperfections are: that, to different eyes, and under different circumstances of the same eye, the length of the focal distance, that suits distinct vision, will vary; and, of course, the quantity of the measures, given by the scale, are liable to a small variation. The goodness of the telescope is, also, in some degree, impaired, by the application of this contrivance of a divided object-glass.

It should be noted, that the wire and object-glass micrometers, were both adapted, in their turns, to the same achromatic telescope; and the comparative observations made as near to each other, in point of time, as possible.

The diameters of the sun, measured by the ten-inch sextant, were taken with a small achromatic telescope, magnifying about twelve times, and were observed on the limb, and on the arch of excess, several times alternately; the measures being always finished in the same direction of the micrometer's screw: and the quarter of the double measure was used as the semidiameter, with the addition of 3″; which is the known diminution of the image of the sun's semidiameter, after the reflections and refractions it undergoes in the process. As the three kinds of micrometers, just described, are so completely different from each other, in their construction, adjustment, and mode of mensuration, I consider them as fully sufficient to make an experiment on the probable consistency of the results which may be obtained

obtained from different good micrometers; and shall now proceed to give a detail of the actual observations.

1794.		S. D^{r}. ⊙.	Semidiameters of ⊙, as given in the Nautical Almanack.
August 26,	D. O. G. Micr^{r}.	15′. 53″,835	15′. 53″,52.
	Wire Micr^{r}.	15′. 54″,03	
Sept^{r} 3,	D. O. G. Micr^{r}.	15′. 56″,01	15′. 55″,4.
	Wire Micr^{r}.	15′. 55″,9	
	A set of ten, all agreeing on the sextant, on the limb, and arch of excess	15′, 55″,0	
Sept^{r} 11,	I. T. S. V. D. O. G. Micr^{r}. 3. 5. 1. 19.	15′. 56″,54	15′. 57″,4.
	Error of V. + 2.		
	R. D. ⊙ S. D^{r}. W. Micr^{r}. 15. 41.	15′. 57″,1	
	Sextant, 15′. 55″.+3″.	15′. 58″,0	
Sept^{r} 17,	R. D$^{'s}$. D^{r} of ⊙ 15. 43. W. Mic^{r}.	15′. 58″,3	15′. 58″,9.
	Sextant,	15′. 59″,3	
Sept^{r} 27,	D. O. G. Micr^{r}	16′. 1″,85	16′. 1″,7.
	Wire Micr^{r}	16′. 1″,95	
	Sextant + 3″,	16′. 1″,70	

1794,		S. D^{r}. ☉	Semidiameters of ☉, as given in the Nautical Almanack.
Oct^{r} 4,	D. O. G. Micr^{r}.	16′. 3″,76	16′. 3″,6.
	Wire Micr^{r}.	16′. 4″,1	
Oct^{r} 6,	Sextant + 3″,	16′. 3″,0	

The wire micrometer measures, taken from this time till the next vernal equinox, are omitted; inasmuch, as being taken nearly in a vertical circle, the excess of the effect of refraction on the sun's L. L., required a correction from the tables of refraction; which is liable to some degree of uncertainty at low altitudes. They were found, however, to agree very nearly.

Dec^{r} 14. By a set of measures of the sun's diameters, on the limb and arch of excess, taken, with great care, parallel to the horizon, images extremely distinct, and no discernible spring whatever in the index.

	☉'s S. D^{r}. + 3″ =	16′. 18″,0
Dec^{r} 15,	D. O. G. Micr^{r}.	16′. 17″,83

			Semidiameters of ☉, as given in the Nautical Almanack.
Dec^{r} 29,	D. O. G. Micr^{r}.	16′. 18″,9	16′. 19″,2.
	Sextant + 3″,	16′. 18″,0	

1795.			
Feb^{y} 16,	D. O. G. Micr^{r}.	16′. 13″,45	16′. 13″,7.
	Set of good observations with sextant,	16′. 13″,0	

1795.

March 30th and 31st. Day very favourable; various sets of measures taken with divided object-glass and wire micrometers. The extremes of the divided object-glass micrometer measures never exceeding 1″. Those of the wire micrometer 0.

	S. D^{r}. ⊙.
D. O. G. Micr^{r}.	16′. 2″,45
* Wire Micr^{r}.	16′. 1″,9

June 8th. The two different micrometers were applied to the 42-inch achromatic telescope, and the scales verified.

		Semidiameters of ⊙, as given in the Nautical Almanack.
Same day, D. O. G. Micr^{r}.	15′. 46″,95	15′. 48″,1.
Wire Micr^{r}.	15′. 46″,45	

June 9, D. O. G. Micr^{r}.	15′. 46″,95	15′. 48″,0.
Troughton's sextant + 3″,	15′. 48″,0	

June 15, D. O. G. Micr^{r}.	15′. 45″,9	15′. 47″,4.
Wire Micr^{r}.	15′. 46″,7	

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* This curtation of the sun's semidiameter is the effect of the difference of refraction of the L. L. of the sun from the upper.

1795.
June 19. The measures, with the different micrometers, were taken with the greatest care; and a mean of internal and external contacts, of the sun's limb to the micrometer wires, was used as the measure of the sun's disk by the wire micrometer.

	S. Dr. ☉.	Mean apogeal semidiameter of the sun.	Semidiameters of ☉, as given in the Nautical Almanack.
D. O. G. Micrr.	15′. 45″,26	15′. 46″,38	15′. 47″,0.
* Wire Micrr. . .	15′. 47″,505		

The sextant, on June 25th, shewed, from a careful set of measures, the apogeal semidiameter of the sun, 15′. 44″.

On attending to the difference of the sun's apogeal semidiameters, as shewn by the divided object-glass micrometer, and the wire micrometer, I had recourse to some former astronomical records on this subject. By referring to De la Lande's Astronomy, article 1387, I find, that, in the year 1758, De la Caille observed the apogeal semidiameter to be 15′. 47″,2; and that De la Lande, in 1760, made it 15′. 45″,25.

These two measures happen to correspond so exactly with mine, as made with the different micrometers, that it may be a matter of some consequence, to enquire, what kind of

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* This measure comes nearer to the calculated apogeal semidiameter of the sun than the former; but as, at the making of these observations, the state of the air caused the sun's limb to undulate, perhaps the divided object-glass micrometer, having a much greater magnifying power, than was used with the wire micrometer, its observations may have been rendered more uncertain.

of micrometers they used to deduce their respective semidiameters.

It is unnecessary to extend these observations any farther. I shall, therefore, only add to this paper, that it will appear, by comparing the divided object-glass micrometer's measures of the sun's diameters, of December 15, 1794, and of June 19, 1795, that the difference of the perigeal and apogeal diameters of the sun was found to be 65″,14. De la Lande found this difference 64″,8. but he calls it, in round numbers, 65″.

Note. Where no notice is taken of the time of observations, it is to be understood they were taken very near to noon, and as soon after each other as micrometers could be changed.

The originals of these observations, and several others, are to be seen in the registry of observations kept at the Observatory, Armagh, for the years 1794 and 1795.

I have the honor to be,

DEAR SIR,

Your faithful and obedient servant,

JAMES A. HAMILTON.